DELAWARE HEALTH AND SOCIAL SERVICES
Division of Public Health
Office of Drinking Water

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TAPTALK

Information from the Office of Drinking Water · Division of Public Health · Spring 2016

Flint Water, Corrosivity, and Lead

By Keith Harrison

“Get the lead out.” That’s what the residents of Flint, Michigan were telling the state and federal regulators who were in charge of the public drinking water supply. Regulators did reduce the lead levels, but only after numerous children were sickened with lead poisoning and top government officials were forced to resign their positions (with criminal charges pending).

The water crisis in Flint began as a story of political posturing and budgeting. Unfortunately, public health suffered, and many residents lost confidence in the ability of the regulators to ensure clean drinking water to consumers.

The Flint water crisis summary

Prior to the crisis, Flint purchased its drinking water (hereafter: water) from the Detroit Water and Sewerage Department (DWSD). The source of the DWSD water was Lake Huron. Due to the decline of the American automobile industry, Flint’s population dropped by half, thereby decreasing the city’s water demand and revenue. In March 2013, the city council voted to purchase water from the new, uncompleted Karegnondi Water Authority (KWA) as a cost savings measure.

After the council vote, DWSD opposed the switch and terminated their agreement with Flint before KWA finished construction (proposed in late 2016). In the interim, Flint used their backup water supply, the Flint River. Unfortunately, the river water was very corrosive. The corrosivity and a very old distribution system meant that lead, which is common in old distribution systems, could leach into the water from service lines and residential plumbing.

In the months following the switch to using the Flint River as their source water, consumers began complaining that the water was making them sick. Ultimately, the mayor of Flint declared a state of emergency in December 2015 due to the irreversible damage to children from increased blood lead levels.

Corrosion

The cost of corrosion can be expensive because corrosion can damage service lines and household plumbing. It can also impart a bitter taste to the water and leach toxic metals into the water. Corrosion control is a complex science and beyond the scope of this article. Rather than a discussion of the complete science of corrosion control, this article will focus only on corrosion control as it is related to the Flint crisis.

The pH is included in the first analysis when considering the water’s corrosivity since a low pH (below 7.0) can accelerate corrosion. However, Flint River water had a pH of about 7.9 – 8.4. Considering only pH, one might say that the water shouldn’t be corrosive. However, pH is only part of the criteria for determining corrosivity.

It turned out that the key concern was chloride in regard to the Flint River. The river water is unnaturally high in chloride, probably due to the application of road salt during the winter months. Chloride is an ion that will increase corrosion by increasing conductivity (think of cars rusting due to winter road salt). Since many of the service lines were made of iron, these lines were vulnerable to the unusually high chloride in the river water. In fact, the local General Motors engine plant told the city of Flint in October 2014 that it would stop using the Flint water since the water was causing engine parts to rust. This decision cost the city $400,000 per year in revenue.

Iron corrosion also causes another problem — dissolved iron consumes chlorine making it difficult to maintain a chlorine residual throughout the distribution system. Without a free chlorine residual, harmful bacteria may grow in the water lines. In August 2014, the city of Flint advised residents to boil their water due to the presence of *E. coli* in the water. In addition, a Legionnaires’ disease outbreak in Flint may be tied to the water crisis.

In an effort to raise the free chlorine residual, the city added more chlorine to the water. Unfortunately, the additional chlorine caused high levels of disinfection byproducts that were in exceedance of federal regulations. Disinfection byproducts may cause cancer with chronic exposure to levels above the federal maximum.

Corrosion control

In retrospect, Flint needed some form of corrosion control after switching to the river water. But officials did not implement a formal corrosion control plan. Instead, they were using lime to soften the hard river water. Since lime is a recognized corrosion control agent, they assumed that the lime would be effective against corrosion. It wasn’t because the lime was used for softening, which raised the pH. Then an acid was introduced to the water to lower the pH down to about 7.3. This pH was too low under these circumstances and proved to be very corrosive.

Lead in drinking water

Iron wasn’t the only metal leached from the distribution system. Many of the aging pipes contained lead or were made entirely of lead. In addition, a large number of older homes in the city had plumbing with lead solder joining the pipes.

A crisis of this magnitude does not develop overnight. Normally, corrosion is a slow and invisible process. In Flint, things were different. Right after the city started using the river water, residents started complaining about brown, discolored water with an unpleasant odor. Lead was probably present in the water at this time, although testing didn’t reveal lead until months later.

The EPA’s Lead and Copper Rule was created to prevent exposure to lead from drinking water. The Michigan Department of Environmental Quality (MDEQ) was following the guidance for the Lead and Copper Rule, but it can take months to years to fully implement the rule when switching to a new water source.

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The Administrator's Corner

By Ed Hallock

Program Administrator, Office of Drinking Water

Flint, Michigan used to bring to mind auto factories or maybe rust belt city. Now the name has become synonymous with lead in drinking water. The front page article provides a good synopsis of what happened in Flint.

I have been responding to numerous media requests about whether it can happen here in Delaware. I am comfortable responding that it is very unlikely that a community in Delaware could have an occurrence like we see in Flint. There are several reasons for my confidence. First, none of our water systems use lead service lines. Some had, and still may have, lead goose necks, but none have complete service lines made of lead. In addition, due to the generally corrosive nature of our groundwater, most homes use PVC pipe for interior plumbing. Fewer old homes in Delaware use copper that may have had lead solder. Finally, the lead/copper rule (LCR) is the only rule for which I have a rule manager dedicated to tracking compliance and working with our water systems to ensure they conduct their monitoring appropriately and during the proper monitoring period.

Now, with all of the above said, the current crisis in Flint does point out that no program is fool proof and this is a good time to review our policies and procedures implementing the LCR. The EPA has been requesting updates from the states on how we are implementing the rule and so we will be providing updates to our water systems to ensure you are implementing the rule in accordance with state and EPA guidance. As always, if you have questions, you should contact my office.

In other news, my office has had our first revised total coliform rule (RTCR) treatment technique triggers. We have had a Level 1 Assessment and a Level 2 Assessment trigger. My staff worked with the triggering water systems to complete the assessments. Sanitary defects were identified in both instances that may have been contributing factors. We will now be working with those systems to correct the sanitary defects identified within the 30-day time period stipulated in the rule. It has been a good exercise for my staff and we will be adjusting our practices to make the process as easy and understandable as possible.

In closing, you can expect more information coming out of the Office of Drinking Water this year and more oversight as we incorporate new regulations (RTCR) and proper implementation of older regulations (LCR). Some of that additional information will be found in the Drinking Water Regulatory Information column which will highlight a different regulation in each issue of *TapTalk*.

Drinking Water Regulatory Information — Arsenic Rule

By Kevin Cottman

The Arsenic Rule applies to all community water systems and non-transient non-community water systems. The maximum containment level (MCL) for arsenic is 10 µg/L. The implementation of the Arsenic Rule results in the avoidance of 16 to 26 non-fatal bladder and lung cancers per year. It also results in the avoidance of 21 to 30 fatal bladder and lung cancers per year. The rule also provides a reduction in the frequency of non-carcinogenic diseases.

The initial monitoring required that all water systems take one sample from each of its distribution entry points (DEP). If the initial results were below the MCL, then ground water systems were required to collect one sample every three years from each DEP and surface water systems were required to collect one sample annually from each DEP. If a system had a result above the MCL, that system collected quarterly samples from the exceeding DEP until it was reliably and consistently below the MCL.

Compliance for systems that are on quarterly monitoring is based on a running annual average (RAA). This means the system must take quarterly samples for one year and the results of the four quarterly samples are averaged together. The average of those samples will be used to determine system compliance. However, any time one sample is high enough that the average with the other samples will cause an exceedance, the system would be out of compliance immediately. For example, if the first round of sampling showed that the system had an arsenic level of 50 µg/L, the result is greater than four times the MCL and would trigger a violation.

Water systems that get results below the MCL have the option to reduce their monitoring to novennial monitoring. In order to qualify for this ground water systems must collect three rounds of triennial monitoring and surface water systems must collect three rounds of annual monitoring. The Office of Drinking Water's policy is that all the arsenic results must be less than 25 percent of the MCL in order to qualify for the nine year waiver. More information regarding this rule and other rules can be found on EPA's website www.epa.gov/your-drinking-water. You can also contact us with questions regarding your water system.

Arsenic is toxic to bacteria, insects, and fungi. Since the 1940s, arsenic was used as a wood preservative in the form of chromated copper arsenate (CCA). CCA-treated lumber is also known as pressure-treated lumber. Although the EPA has not banned CCA, manufacturers discontinued manufacturing products for residential uses in 2003.

Waterborne Disease Spotlight — Lead Poisoning

By Keith Mensch

Identification: Lead poisoning is manifested by elevated blood lead levels as a result of exposure to lead in water, food, soil, dust, or air. It is dependent on a cumulative dose of lead and the vulnerability of the person exposed.

Symptoms: Exposure to lead can cause the accumulation of lead in the teeth and bones. It can cause damage to the nervous and reproductive systems and the kidneys. It can also cause high blood pressure and anemia. Lead poisoning can be diagnosed by a blue line around the gums. Exposure to lead in children can have neurotoxic effects leading to behavioral and developmental disabilities. At very high levels, lead can cause convulsions, coma, and death. No safe blood lead level exists for children. Exposure of pregnant women to high levels of lead can cause miscarriage, stillbirth, premature birth and low birth weight, as well as minor birth defects. Inorganic lead is a likely human carcinogen.

Occurrence: Lead exposure is estimated to cause 143,000 deaths per year worldwide, with the majority occurring in developing regions. Childhood exposure to lead is estimated to contribute to approximately 600,000 new cases of behavioral and developmental disabilities annually.

Sources of Exposure: Water, food, soil, dust, and air may contain lead from various sources including manufacturing and industrial processes (e.g., smelting and the production of lead-acid batteries), lead-based paint, the use of leaded gasoline, lead drinking water pipes, drinking water pipes containing lead solder, and plumbing fixtures containing brass made with lead.

Modes of Exposure: Inhalation of lead particles generated from the burning of materials that contain lead. Ingestion of lead-contaminated dust, water, and food.

Susceptibility: Susceptibility is general, but children are particularly vulnerable due to the lack of having a fully developed blood-brain barrier, increased gastrointestinal absorption, and more frequent hand-to-mouth contact. Iron deficiency can also exacerbate lead absorption.

Preventive Measures:

- Surveillance of potentially exposed and vulnerable populations, e.g., screening of children for blood lead levels
- For drinking water: replacement of lead pipes, lead soldered pipes, and plumbing fixtures containing lead; treatment of corrosive water; cold-water flushing of drinking water taps by consumers
- Enforcement of occupational health standards
- Eliminating the use of lead solder in food cans
- Proper abatement of existing lead-based paint during building renovation projects

Drinking Water Facts: Lead is not typically found in source water. Lead was historically used in plumbing materials for drinking water. Lead leaches into drinking water through the corrosion of plumbing materials that contain lead. Replacement of plumbing materials containing lead should be done whenever possible, including full replacement of lead service lines (partial replacement has not been found to decrease blood lead levels in children), replacement of lead main lines, and replacement of plumbing fixtures that contain lead. Corrosiveness of drinking water should be maintained to reduce the risk of leaching lead into the water from plumbing materials.

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Regulatory concerns

Keith Creagh, the current director of MDEQ, testified to Congress on February 3, 2016 that state officials “relied on technical compliance instead of assuring safe drinking water.” He also added, “It is noteworthy that the Lead and Copper Rule would have allowed up to 24 months to begin these [corrosion control] treatments.”

Joel Beauvais, deputy assistant administrator of the EPA also testified before Congress on February 3, 2016: “The situation that gave rise to the current crisis in Flint – a large public water system switching from purchasing treated water to using an untreated water source – is highly unusual.”

The Flint water crisis is not over. A number of children have been exposed to irreversibly damaging levels of lead. Sadly, the cumulative health effects from that exposure, lower IQ, learning problems, attention problems, may take years to show up in the population affected. Furthermore, the impact on the city in future years will be higher special education costs and other social services related to the health effects of lead exposure.

- Inspiration for this article came from the research and writings of Dr. Marc Edwards and the Virginia Tech Research Team.

Approved Sampler/Tester (AST) Training

An approved sampler/tester is certified by Delaware Health and Social Services for conducting routine water sampling and water quality analyses. The approved sampler/tester works under the direction of a fully licensed water operator. During training, the participant will learn about water-borne bacteria and the Total Coliform Rule that regulates bacteria in drinking water. They will also learn about other chemicals and compounds that may enter drinking water. The focus of the training is to help participants understand drinking water regulations in relation to public health. Continuing Education Credits (CEUs) will be offered for these trainings.

Upcoming Approved Sampler/Tester (AST) Trainings

Email registration is required for all trainings. Send email registration request to: Keith.Harrison@state.de.us

AST Basic (3 CEUs)

The Basic course is a three-hour training for those new to the AST program.

AST Basic, 9:00 a.m. – 12:00 p.m.

April 14, 2016, Dover
May 12, 2016, Dover
June 9, 2016, Dover
July 14, 2016, Dover
August 11, 2016, Dover
September 8, 2016, Dover
October 13, 2016, Dover
October 20, 2016, 8:30 a.m., Milford
November 10, 2016, Dover

AST Refresher (1 CEU)

Bring your testing kit if you have one.

AST Refresher, 9:00 – 10:00 a.m.

April 28, 2016, Dover
May 26, 2016, Dover
June 23, 2016, Dover
July 28, 2016, Dover
August 25, 2016, Dover
September 22, 2016, Dover
October 27, 2016, Dover
October 28, 2016, 8:30 a.m., Milford
November 17, 2016, Dover

Training Locations

Dover:
Office of Drinking Water, 43 S. DuPont Hwy.
(Edgehill Shopping Center) Dover, DE 19901

Milford:
Delaware Rural Water Association
210 Vickers Drive, Milford, DE 19963

Office of Drinking Water
Edgehill Shopping Center
43 S. DuPont Highway
Dover, DE 19901
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